THE

ONTARIO WATER RESOURCES

COMMISSION

A Report of an

INDUSTRIAL WASTE SURVEY

of

THE ALGOMA STEEL CORPORATION, LIMITED

Sault Ste. Marie

1970

A

Report On

An Industrial Wastes Survey

of

THE ALGOMA STEEL CORPORATION, LIMITED

Sault Ste. Marie

August 26, 27, 1970

Division of Industrial Wastes

ONTARIO WATER RESOURCES COMMISSION

ONTARIO WATER RESOURCES COMMISSION

REPORT ON FIELD INVESTIGATIONS

DATE OF EXAMINATION - August 26, 27, 1970 PLACE - Sault Ste. Marie, Ont.

MATTER INVESTIGATED - THE ALGOMA STEEL CORPORATION, LIMITED

AT REQUEST OF - Routine

INSPECTION MADE IN COMPANY WITH-

OTHER PARTIES SEEN -

REPORTS TO BE SENT TO -

The Algoma Steel Corporation, Limited (5 copies)

J. R. Barr, Director, Division of Sanitary Engineering

Mr. A. A. Jackson, City Engineer, City Hall, Sault Ste.Marie

Mr. J. A. Moore - Sault Ste. Marie Office

Mr. L. Fitz - Sudbury Office

OTHER RECOMMENDATIONS TO THE OFFICE RE PROCEDURE TO FOLLOW -

REPORT BY J. D. Luyt

NOTE: This completed form to be attached to each report.

Typed Feb.17/71

REPORT

Ontario Water Resources Commission

Municipality Sault Ste. Marie Date of Inspection August 26, 27, 1970

Re: THE ALGOMA STEEL COPORATION, LIMITED

Field Inspection by J. Foster, J. D. Luyt Report by J. D. Luyt

An industrial waste survey was conducted at The Algoma Steel Corporation, Limited, Sault Ste. Marie on August 26 and 27, 1970. The survey was designed:

a) to determine the waste loadings discharged to the St. Marys River.

b) to determine the effectiveness of the Company's existing waste control systems in eliminating or reducing the potential to impair the receiving watercourses, D'avignon Creek and the St. Marys River, and

c) to indicate to the Commission and the Company those areas or operations within the plant still requiring improved waste control and disposal systems and procedures.

SUMMARY

The Algoma Steel Corporation, Limited, located on the St. Marys River in Sault Ste. Marie is a fully integrated steel works having a capacity of some 2,600,000 ingot tons of steel per year. Positive steps have been taken by the Company to improve the quality of the waste effluents discharged. However, major problems still remain and are outlined in more detail in the body of this report. The most significant

...2

problem areas include the high cyanide concentrations in the Dorr Thickener and Terminal Basin effluents.

It is recommended that The Algoma Steel Corporation, Limited develop and implement the necessary waste control and treatment measures to eliminate these sources of water impairment.

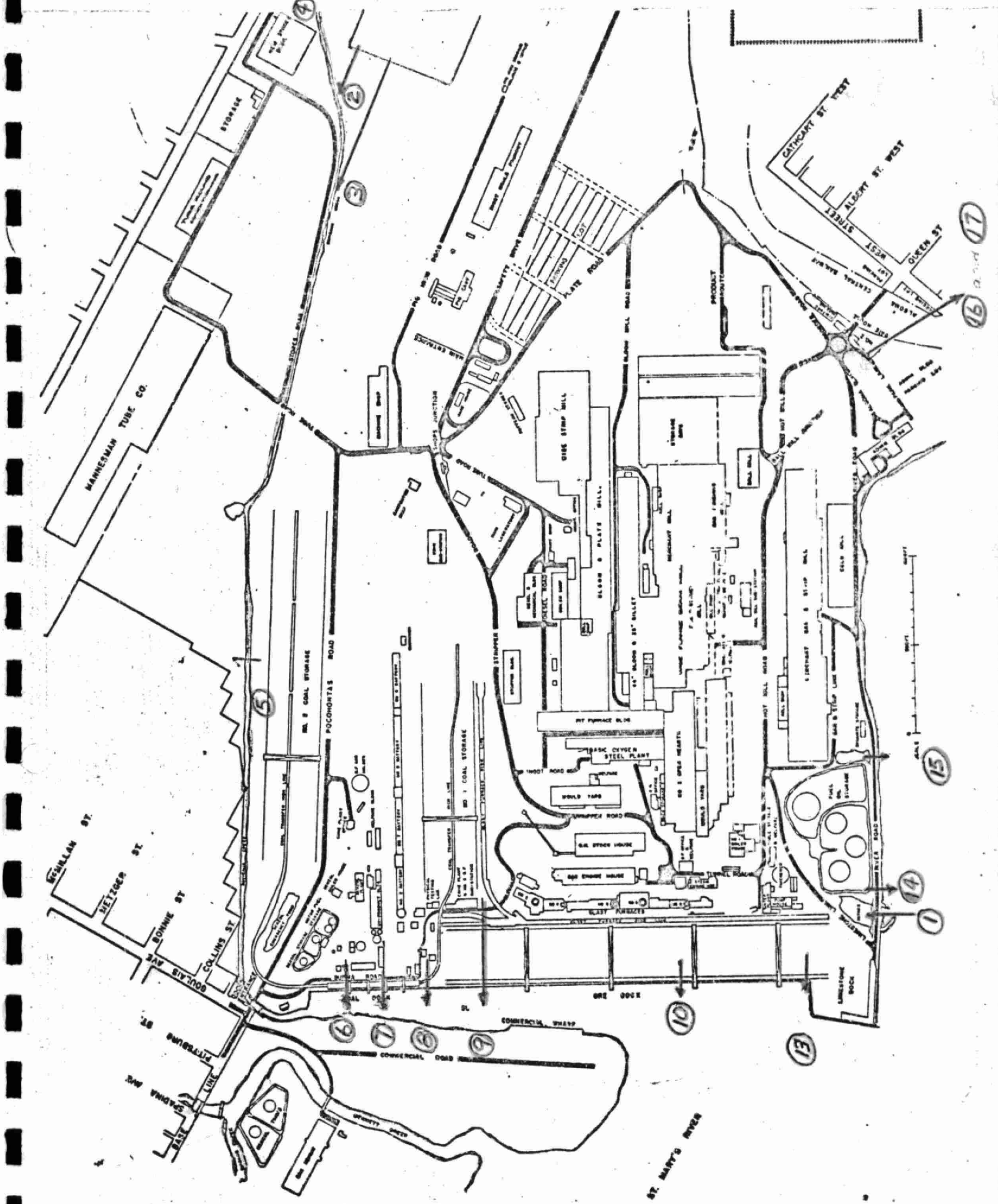
Sampling Programme and Analytical Results

The sampling programme at The Algoma Steel Corporation, Limited was carried out on August 26 and 27, 1970. The sampling points are listed below and are shown on Figure No. 1.

Flow (IGPD)	Sample Point	Description
-	1	Service Water
350,000	2	24" Cold Mill acid sewer to D'Avignon Creek
720,000	3	20" Cold Mill sewer to D'Avignon Creek
-	4	D'Avignon Creek upstream of all operations
-	5	D'Avignon Creek downstream of the oil skimming device
1,300,000	6	12" Benzol Plant sewer
1,440,000	7	15" By-product Plant sewer (not sampled)
1,730,000	8	24" Coke Quench sewer
4,320,000	9	30" Blast Furnace Cooling and Yard drain sewer
4,320,000	10	60" Blast Furnace sewer
-	11	Dorr Thickener influent
18,720,000	12	Dorr Thickener effluent
-	13	3'-9" x 3'-9" Dorr Thickener outfall to boat slip
-	14	Boiler House sewer
15,840,000	15	Bar and Strip Mill outfall to St. Marys River
-	16	Terminal Basin influent
75,000,000	17	Terminal Basin effluent
(160,000)	18	Input to Phenol Recovery Plant
-	19	Treated Liquor from Phenol Recovery Plant
-	20	Contents of West Pond in Landfill area
-	21	Contents of East Pond in Landfill area
Total 123,740,000 GPD		(Phenol plant flow included in Terminal Basin flow)

The analytical results are tabulated in Table I

...3


MANNESMAN TUBE CO.
STORAGE
POCOHONTAS ROAD
NO. 2 COAL STORAGE
NO. 1 COAL STORAGE
STRIPPER ROAD
PIT FURNACE BLDG
BASIC OXYGEN STEEL PLANT
MOULD YARD
BLAST FURNACES
ORE DOCK
LIMESTONE DOCK
COMMERCIAL WHARF
COMMERCIAL ROAD
FUEL OIL STORAGE
COLD MILL
BLOOM & PLATE MILL
CATHCART ST. WEST
ALBERT ST. WEST
QUEEN ST
WEST STREET
MCMULLAN ST.
WETZIGER ST.
BONNIE ST
COLLINS ST.
GOULAIS AVE
PITTSBURG ST.
BASE LINE
ST. MARY'S RIVER
1
2
3
4
5
6
7
8
9
10
13
14
15
16 and 17

[redacted]

TABLE I

"ALL RESULTS EXCEPT PH IN PPM UNLESS NOTED OTHERWISE"

SAMPLE DESCRIPTION	BOD 5	COD	SUSP SOLIDS	DISS SOLIDS	PH	ACIDITY AS $CaCO_3$	TOTAL IRON	DISS IRON	ETHER SOLUBLES	PHENOLS IN PPB	CYANIDE AS CN^-	SULPHIDE AS $S^=$	FLUORIDE AS F^-	AMMONIA NITROGEN AS N	KJELDAHL NITROGEN AS N	PHOSPHATE AS P	OTHERS
1. SERVICE WATER																	
(COMP. 10:00AM- 4:00PM-AUG.26)	1.6	< 10	5	65	7.2	-	0	0	2	0	< 0.01	0	-	0.6	0.84	0.022	-
(COMP. 9:15AM- 4:00PM-AUG.27)	-	-	5	80	-	-	-	-	-	0	< 0.01	-	-	0.2	1.4	0.01	$SO_4^=$: 2
																	CL^- : 2
2. 24" COLD MILL ACID SEWER																	
(7 HR. COMP.-AUG.26)	50	-	25	295	4.9	71	20.5	20.0	19	4	< 0.01	-	-	0.4	0.51	0.006	-
(7 HR. COMP.-AUG.27)	46	-	35	365	3.4	170	38	38	41	0	0.02	-	-	-	-	0.34	CL^- : 1.1
3. 20" COLD MILL SEWER																	
(7 HR. COMP.-AUG.26)	50	-	15	125	7.2	-	0	0	20	5	< 0.01	-	-	0.1	0.67	0.26	-
(7 HR. COMP.-AUG.27)	4	-	30	130	7.4	-	0	0	27	0	< 0.01	-	-	-	-	-	$SO_4^=$: 5
																	CL^- : 0.95
4. D'AVIGNON CREEK UPSTREAM																	
(GRAB. 3:45PM-AUG.27)	8	-	10	190	8.3	-	0	0	TRACE	1250	0.00	0	-	0.2	0.46	0.058	-
5. D'AVIGNON CREEK DOWNSTREAM																	
(7 HR. COMP.-AUG.26)	40	-	15	185	6.8	-	3.8	0	7	0	< 0.01	-	-	0.1	0.37	0.025	-
(7 HR. COMP.-AUG.27)	38	-	45	215	6.2	-	0.38	0.38	7	0	0.00	-	-	-	-	0.043	$SO_4^=$: 26
																	CL^- : 40
6. 12" BENZOL PLANT SEWER																	
(7 HR. COMP.-AUG.26)	38	-	10	90	7.1	-	0	0	3	0	0.00	-	-	0.1	0.31	0.013	-
7. 15" BY-PRODUCT PLANT SEWER	NOT SAMPLED																
8. 24" COKE QUENCH SEWER																	
(7 HR. COMP.-AUG.26)	8	-	10	130	7.7	-	0.0	0.0	TRACE	0	0.00	0	0.1	0.50	0.90	-	-

SAMPLE DESCRIPTION	BOD 5	COD	SUSP SOLIDS	DISS SOLIDS	PH	ACIDITY AS $CaCO_3$	TOTAL IRON	DISS IRON	ETHER SOLUBLES	PHENOLS IN PPB	CYANIDE AS CN^-	SULPHIDE AS $S^=$	FLUORIDE AS F^-	AMMONIA NITROGEN AS N	KJELDAHL NITROGEN AS N	PHOSPHATE AS P	OTHERS
9. 30" BLAST FURNACE COOLING AND YARD DRAIN																	
(7 HR. COMP.–AUG.26)	8	–	0	100	8.8	–	0.7	0.0	TRACE	0	0.00	0	–	0.60	0.85	0.016	–
10. 60" BLAST FURNACE SEWER																	
(GRAB. 2:00PM–AUG.26)	2.5	15	10	50	8.6	–	1.1	0.0	–	–	0.00	0	0.2	–	–	–	–
11. DORR THICKENER INFLUENT																	
(COMP. 9:30AM– 4:30PM–AUG.26)	–	–	8060	210	10.1	–	2520	53.6	–	–	0.00	0	1.0	–	–	–	–
12. DORR THICKENER EFFLUENT																	
(COMP. 9:30AM– 4:30PM–AUG.26)	–	–	40	180	7.7	–	13.8	0.0	–	–	5.1	0.1	2.4	–	–	–	–
(COMP. 9:30AM– 4:30PM–AUG.27)	–	–	20	230	7.6	–	7.6	2.0	2	0	4.4	–	4.8	–	–	–	$SO_4^=$: 10 CL^- : 30
(GRAB. 9:30AM – AUG.27)	SELENIUM AS SE : < 2PPM																
13. 3'–9" X 3'–9" THICKENER OUTFALL TO BOAT SLIP																	
(COMP. 9:30AM– 4:00PM–AUG.26)	–	–	15	285	7.7	–	13.0	0.0	–	–	2.7	0	1.8	–	–	–	–
14. BOILER HOUSE SEWER																	
(COMP. 9:30AM– 4:30PM–AUG.26)	1.4	< 10	10	40	–	–	0.0	0.0	3	0	0.00	0	–	0.1	–	–	–
15. BAR AND STRIP MILL OUTFALL																	
(COMP. 9:30AM– 4:30PM–AUG.26)	13	90	45	55	–	–	2.3	0.0	23	0	0.00	0	–	0.01	–	0.52	–
(COMP. 9:15AM– 4:00PM–AUG.27)	–	–	25	95	8.3	–	2.0	0.0	15	0	< 0.01	–	0.3	–	–	–	$SO_4^=$: 3 CL^- : 3

SAMPLE DESCRIPTION	BOD 5	COD	SUSP SOLIDS	DISS SOLIDS	PH	ACIDITY AS $CaCO_3$	TOTAL IRON	DISS IRON	ETHER SOLUBLES	PHENOLS IN PPB	CYANIDE AS CN^-	SULPHIDE AS $S^=$	FLUORIDE AS F^-	AMMONIA NITROGEN AS N	KJELDAHL NITROGEN AS N	PHOSPHATE AS P	OTHERS
16. TERMINAL BASIN INFLUENT																	
(COMP. 9:15AM- 4:30PM-AUG.26)	-	15	40	120	8.8	-	0.9	0.0	7	1250	7.5	40	-	49	50	0.028	-
(COMP. 9:00AM- 4:00PM-AUG.27)	-	-	20	180	9.1	-	13.0	2.8	12	1000	8.0	-	0.4	-	-	-	$SO_4^=$: 24 CL^- :101
17. TERMINAL BASIN EFFLUENT																	
(COMP. 9:15AM- 4:30PM-AUG.26)	-	-	10	140	9.1	-	2.2	0.0	4	1500	4.5	50	0.4	50	60	0.044	-
(COMP. 9:00AM- 4:00PM-AUG.27)	-	-	20	180	9.1	-	5.0	0.0	8	1000	8.4	-	0.4	-	-	-	$SO_4^=$: 22 CL^- : 92
18. INPUT TO PHENOL PLANT																	
(7 HR. COMP. - AUG.27)	-	-	45	955	8.8	-	-	-	235	600,000	-	-	-	4400	5300	-	-
19. TREATED LIQUOR FROM PHENOL PLANT																	
(7 HR. COMP. - AUG.27)	-	-	105	13,100	8.8	-	-	-	30	25,000	-	-	-	4400	5300	-	-
20. WEST POND-LANDFILL AREA											COLOUR OF POND			COPPER	NICKEL	$SO_4^=$	CARBONATE ALKALINITY
(GRAB. - 3:00PM - AUG.26)	-	-	5	195	11.1	0	0.0	-	-	-	BLUE-GREEN	0	0.5	0.0	0.0	50	120
21. EAST POND-LANDFILL AREA																	
(GRAB. - 3:00PM - AUG.26)	-	-	5	245	10.8	0	0.0	-	-	-	NO COLOUR	0	-	0.0	0.0	69	84

The 15" by-product plant sewer was not sampled because a vessel had tied up at the dock, blocking access to the outfall.

WASTE LOADINGS

The following net (gross loadings less service water loadings) waste loadings have been calculated.

Flow	-	124 MIGPD
5-day BOD	-	3,040 lbs/day
Suspended solids	-	13,200 lbs/day
Dissolved solids	-	89,500 lbs/day
Iron as Fe	-	5,220 lbs/day
Ether solubles	-	5,960 lbs/day
Phenols	-	940 lbs/day
Cyanide as CN^-	-	5,720 lbs/day
Kjeldahl Nitrogen as N	-	44,200 lbs/day
Ammonia as N	-	37,200 lbs/day
Total Phosphorous as P	-	100 lbs/day
Fluoride as F^-	-	1,030 lbs/day
Sulphide as $S^=$	-	37,500 lbs/day
Sulphate as SO_4	-	16,700 lbs/day
Chloride as Cl^-	-	72,900 lbs/day

..8

DISCUSSION OF RESULTS

Cold Mill

The two Cold Mill sewers discharging wastewater to D'avignon Creek were responsible for sever impairment of the creek. The characteristics of both waste flows were unacceptable for discharge to a watercourse. The 24" acid sewer contained high concentrations of dissolved iron, oil and had a low pH. The 20" sewer discharge to the creek had high concentrations of oil. Visual observations at the site indicated that the oil retention and removal facilities operating on this waste flow were effective in removing the free oil present but were not effective in removing the soluble oils contained in the effluent. The discharge from the oil removal facility was milky white in appearance, indicating the presence of signficant amounts of emulsified oils.

The impairment of D'avignon Creek caused by these two discharges is evident by comparing the analytical results obtained on the "upstream" and "downstream" samples. (NOTE: downstream samples were taken below the Algoma Steel baffle on the creek and therefore include Mannesmann Tube Company Limited's contribution. However, the samples also take into account any oil removed by the oil removal device at the baffle which has been installed in the ditch.)

These samples show the following increases:-

BOD_5:	from 8 ppm	to 39 ppm
suspended solids:	from 10 ppm	to 15-45 ppm
pH:	from 8.3	to 6.2-6.8
iron:	from 0	to 0.4-3.8 ppm
ether solubles:	from a trace	to 7 ppm

...9

In addition, during this latest as well as during previous visits to the site, appreciable amounts of free oil were seen floating on the water at the mouth of the creek. Because the flow in the creek is relatively small, it is necessary to provide more efficient and effective treatment of the waste flows entering it.

The baffle placed across the creek can not be considered a treatment system. It is considered solely as a last measure of defence against large (or small) losses of oil to the St. Marys River. Ideally, no oil should reach the baffle.

During a meeting between Company and OWRC personnel in July, 1970 it was indicated that the results of an experimental testing programme to break the oil-water emulsion was to be completed by September, 1970. The results of this programme have shown that pickle liquor, a caustic solution, and dissolved air flotation can separate the oil on a laboratory scale. A decision on the full scale use of this system as an alternative to other means of eliminating this source of impairment must now be made.

Sewers Discharging to the Boat Slip

The sewers discharging to the boat slip are:

1) 12" Benzol Plant sewer
2) 15" By-Product Plant sewer
3) 24" Coke Quench sewer
4) 30" Blast Furnace Cooling and Yard Drain
5) 60" Blast Furnace Sewer

(The Dorr Thickener outfall will be discussed in the next section)

..10

The waste effluents discharged by these sewers at the time of sampling were generally satisfactory for discharge to a watercourse. However, the 24" Coke Quench sewer has, in the past, contained excessive quantities of suspended solids. The 15" By-Product Plant sewer was not sampled during the survey because a vessel at the dock blocked access to the outfall.

Dorr Thickener Effluent

The suspended solids and iron concentrations in the Dorr Thickener effluent were reasonably low at the time of sampling. Much higher concentrations have been recorded in the past. However, the visible detrimental effect of this discharge is not indicated by the analytical results. At all times during the sampling period the discharge to the boat slip was a reddish brown colour and visibly discoloured a large area of the receiving water. A report received in November, 1970, from the OWRC Water Quality Surveys Branch described a reddish discolouration in the St. Marys River originating at the Dorr Thickener outfall and extending through the power canal to the mouth of Fort Creek and further downstream before dissipation.

The cyanide concentrations in the Thickener effluent, at 4.4 and 5.1 ppm were not acceptable and must be considered a high priority problem.

..11

Cyanide concentrations in the St. Marys River obtained during sampling surveys conducted in May and July, 1969, were:

Distance Downstream of Trunk Sewer Outfall	May CN^- (ppm)	July CN^- (ppm)
0 ft.	4.1	9.5
50 ft.	2.1	6.1
200 ft.	0.84	4.0
1000 ft.	0.45	1.3

Cyanide concentrations found in the St. Marys River during 1970 at various locations were:

Distance Downstream of Fort Creek	Distance from Canadian Shore	June 12	June 18	Nov 7-11
3,800 ft.	200 ft.	0.01	0.10	0.07
5,200 ft.	200 ft.	0.02	0.06	0.08
6,800 ft.	100 ft.	-	-	0.09
10,800 ft.	800 ft.	-	-	0.04

Concentrations a short distance upstream of Algoma Steel during 1970 were 0.01 - 0.03 ppm near the Canadian shore. Wastes discharged to the Algoma boat slip are periodically carried upstream by the action of back-eddies near shore which could account for the cyanides occurring upstream. The OWRC drinking water objectives state that the cyanide concentration in a public water supply should not exceed 0.01 ppm where more suitable supplies are available.

..12

The present flow through the thickener is 13,000 gpm. A new blast furnace and oxygen shop is expected to increase the flow to 17,000 - 18,000 gpm when put into production. A solids separation system capable of satisfactorily handling and treating the increased flow will have to be provided at that time.

Bar and Strip Mill

The waste effluent at the Bar and Strip Mill outfall was unacceptable for discharge to a natural watercourse because of its high suspended solids and ether solubles concentrations. Just prior to the sampling period, the mill was shut down resulting in a drop in the water level in the oil retention basin to below the bottom of the oil retention baffle. This resulted in the loss of oil to the St. Marys River.

The Company was planning to improve the operation of the facility by moving the baffle nearer the outlet to allow better oil-water separation. The facility has not been evaluated since this was done. An application for approval was to have been submitted for the improvements. This, however, was not done.

Terminal Basin

The constituents of concern in the waste effluent in Algoma Steel's main trunk sewer after passing through the terminal lagoon were phenolics, cyanide, sulphide and ammonia.

a) Phenol

A phenol recovery plant operating on the ammonia flushing liquor went onstream during the summer of 1970. The phenol results obtained on the

..13

phenol plant feed and treated liquor indicated a removal efficiency of 96% on a feed containing 600 ppm phenol. Design criteria called for a 98.5% removal on a feed containing 3,500 ppm. More recent data obtained by the Company indicates a feed containing 1,400 - 1,600 ppm and an effluent containing 20-25 ppm.

b) Cyanide

The cyanide concentrations, at 4.5 - 8.4 ppm were high. These high concentrations coupled with the large volume of water discharged to the St. Marys River from the terminal basin (75,000,000 gpd) results in a particularly serious situation. As discussed previously, reduction of cyanide losses at Algoma Steel is considered a priority item. During recent discussions with the Company, doubts concerning the proposed slag bed cyanide treatment system were expressed. The Company's programme calls for cyanide treatment facilities to be in operation by the 1972 year-end.

c) Sulphide and Ammonia

The sulphide and ammonia concentrations in this waste effluent were also high. According to the Company's waste effluent control programme, facilities for the reduction of these contaminants are to be completed during 1972.

Ponds in Landfill Area West of Plant

Grab samples were taken of two of the three ponds which had been formed by dyking projected landfill areas on the Company's water-lots in the St. Marys River upstream of the steelworks. One of these ponds, the westerly or most recently formed pond had a bluish tint. The easterly or earliest formed pond was colourless. It is not known whether the water in the pond was coloured or whether it was the bottom of the pond that imparted the colour. The analytical results reported here indicate very little

..14

difference between the two samples. The blue discolouration was not visible in the collected sample.

RECOMMENDATIONS

It is recommended that:

1. The items included in the Company's waste control programme be proceeded with as scheduled.

2. A decision be made on the methods to be used to reduce the emulsified oil losses to D'avignon Creek from the Cold Mill and construction of the appropriate waste control works be proceeded with as soon as possible.

3. The acid wastes discharged to D'avignon Creek from the Cold Mill be neutralized before discharge. The system devised should include facilities for the removal of the iron and oil also present in the flow.

4. Because the effluent from the Dorr Thickener is approaching or already exceeds OWRC objectives for suspended solids and iron, because the effluent has the capability of discolouring a portion of the receiving water apparently on a continuous basis, and because at certain times the discolouration extends further than the mouth of Fort Creek (1-1/2 miles downstream) it is recommended that an improved treatment system including a second clarifier be constructed, certainly before any additional waste flows from new processing facilities are generated.

Investigations into eliminating the colour of the Dorr Thickener discharge should also be initiated.

5. The cyanide loading to the St. Marys River in the Dorr Thickener overflow be reduced as soon as possible. This is considered a high priority item.

..15

6. The Company's waste effluent monitoring programme commence without delay and the results be forwarded to the Division of Industrial Wastes on a monthly basis.

7. Accidental spills reaching a natural watercourse be reported to the Division immediately after discovery. There have been very few spills reported to the Division in past years. It is highly improbable that accidental spillagesdo not take place from time to time at an industrial complex as large as The Algoma Steel Corporation, Limited. Recent revisions to the OWRC Act have made it mandatory that the Commission be notified without delay of any discharge not in the normal course of events.

8. Similarly, in the event that unusual discharges of contaminants are expected as the result of planned events, the Company should consult with Division personnel before such a discharge takes place. Items included in this category are descaling of lines with acid, by-passing of the phenol plant for any reason, etc.

Prepared by:

J. D. Luyt

J. D. Luyt, Engineer,
Division of Industrial Wastes.

Approved by:

R. C. Stewart

R. C. Stewart, P. Eng.,
Regional Engineer,
Division of Industrial Wastes.

JDL/ek